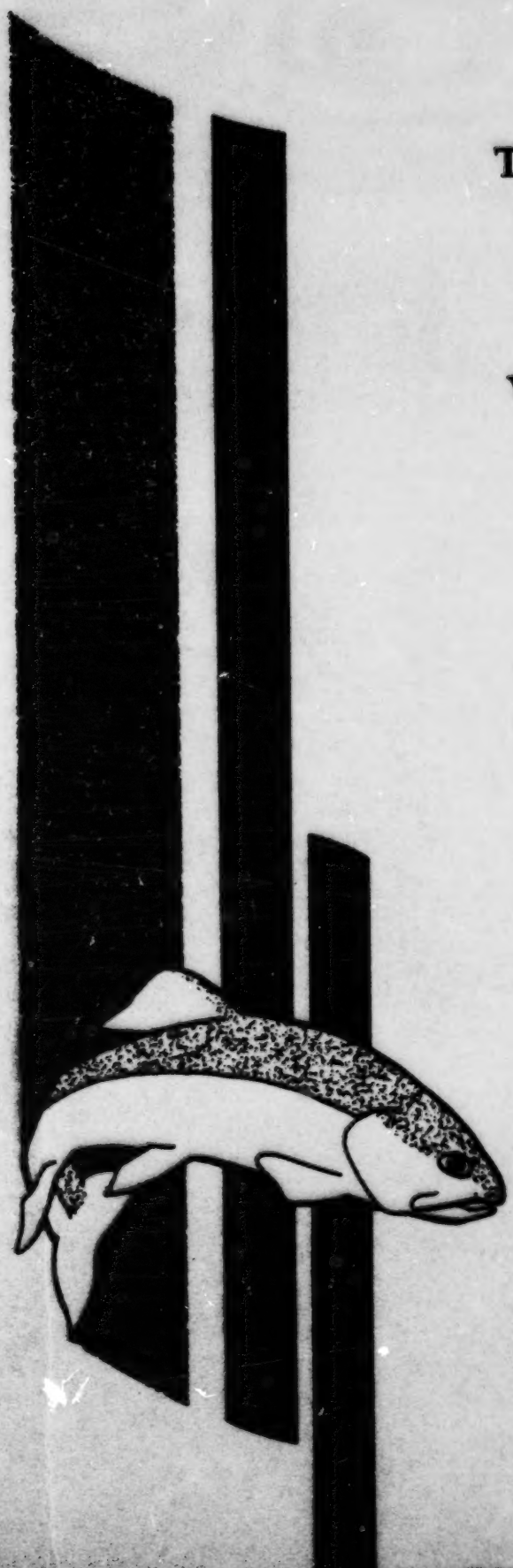

Telemetric Investigations of Winter Steelhead in the Salmon River, Vancouver Island - 1986

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M. G. LIRETTE
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TELEMETRIC INVESTIGATIONS OF WINTER STEELHEAD IN THE SALMON RIVER, VANCOUVER ISLAND 1986

by

M. G. LIRETTE[1]

R. S. HOOTON[2]

[1]Ministry of Environment, Recreational Fisheries Program, 2569 Kenworth Road, Nanaimo, B.C. V9T 4P7

[2]Ministry of Environment, Recreational Fisheries Program, 3726 Alfred Avenue, Bag 5000, Smithers, B.C. V0J 2N0

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ABSTRACT

Lirette, M.G. and R.S. Hooton. 1988. Telemetric Investigations of Winter Steelhead in the Salmon River, Vancouver Island, 1986. Fisheries Technical Circular No. 82. 21 p.

The freshwater migration behaviour of winter-run steelhead (Salmo gairdneri) was studied on the Salmon River (Vancouver Island) between January and June, 1986. Radio telemetry was employed to monitor in-stream movements and to determine time and location of spawning. Between January 30 and May 7, 1986, 217 steelhead were captured by angling and beach seining in the Salmon River. Sixty-one fish were held for broodstock, twenty-eight were radio tagged, thirty-four were anchor tagged, and the remainder were released untagged. The mortality rate from angling was 5.7% (11 of 192 fish caught). Twelve (19%) of the tagged steelhead (four radio-tagged and eight floy-tagged fish) were recaptured by angling. Of 28 radio-tagged steelhead, 23 (82%) were tracked through spawning and 20 (71%) were followed through emigration. Telemetric monitoring showed that tagged steelhead moved quickly through the lower river (0 - 25 km) and occupied stream reaches presently closed to all angling. Radio-tagged steelhead (n = 4) migrated through a canyon located at 38 km and confirmed the successful removal of a migration barrier. Tagged steelhead spawners were distributed throughout the upper watershed, including the mainstem from 25 to 45 km, the Memekay River from 29 km (confluence with the Salmon River) to 40 km, Northfork Memekay River and Cooper Creek. The telemetric monitoring of steelhead tagged in February and late March suggested the existence of two stocks of fish. Fish tagged early utilized the Salmon River mainstem above the Memekay River, spawned during late March and early April, and emigrated between April 15 and May 15, 1986. Steelhead tagged in late March utilized the Memekay River and the Salmon River below the Memekay confluence (29 km), spawned during late April and early May, and emigrated in late May. Implications of the study results to habitat protection, angling regulations and broodstock requirements are discussed.

ACKNOWLEDGEMENTS

The Campbell River Chapter of the Steelhead Society of British Columbia provided valuable equipment essential to the success of this project. The purchase and donation of a radio receiver was appreciated. Fisheries Branch staff, A. F. Tautz, G. E. Reid, and P. D. Law assisted in capture, tagging, and tracking of steelhead. Editing and review of a draft by J. C. Wightman, and B. R. Ward was very much appreciated. Drafting and typing services were provided by D. Tierney and D. Turner.

INTRODUCTION

The winter-run steelhead (Salmo gairdneri) in the Salmon River (Fig. 1) are unique compared to most other steelhead on Vancouver Island. Their average size is considered "large" by anglers and fish over 8 kg are not uncommon (Hooton et al. 1987). These "trophy" fish have traditionally been highly prized by the steelhead sport angler who annually fished 1 500 to 3 000 days to catch 500 to 1 500 steelhead in the Salmon River (B.C. Steelhead harvest Analysis 1970-75). The winter steelhead sport fishery occurs between December and May and is concentrated in the middle (20-27 km) and lower (7-12 km) reaches of the mainstem.

Through a combination of natural and man-induced events, including timber harvest, hydro development and over-harvest by anglers, the number of steelhead has declined since 1975. Preliminary estimates of steelhead production capability suggest the Salmon River is well below its potential (Lirette et al. 1987). In response, the Fisheries Branch of the Ministry of Environment has implemented angling regulations and enhancement programs to reverse the decline of steelhead stocks in the Salmon River. Angling regulations in 1985-86 required the use of a single barbless hook and the release of all wild steelhead captured (those with an adipose fin). No angling was allowed above Big Tree Creek confluence pool (26.8 km). Enhancement activities to date have included habitat assessment to identify productive areas and enhancement opportunities (Ptolemy et al. MS 1977), removal of a large boulder obstruction located in a canyon 38 km above the estuary, log jam barrier alterations in productive tributaries and habitat improvement with large rock placements (Ward and Slaney 1981). A cooperative venture between the Ministry of Environment, Federal Department of Fisheries and Oceans and B.C. Hydro has resulted in the design, funding and installation (1986) of a downstream smolt-screening structure in a water diversion canal located 50 km upstream of the estuary (Bomford and Lirette MS 1988). Steelhead fry were stocked to colonize formerly inaccessible stream habitat (38-50 km) between 1979 and 1984. In 1986 a fry stocking program was initiated to utilize the available habitat above the B.C. Hydro diversion dam and canal.

Prior to 1986, information on the migration behaviour of winter-run steelhead in the Salmon River was limited and was based on sport angler reports. Fisheries managers required improved data on early- and late-run steelhead migration patterns, rates of movement, holding areas, spawning time and location. The information would facilitate the evaluation of past enhancement projects (barrier removal and fry colonization) and improve the current program of stocking fry into the headwaters (time and location of brood stock capture). An evaluation of current angling regulations and recommendations for changes to improve the sport fishery, would result from improved data on migration behaviour. Radio telemetry provided the means to pursue this goal. The technology has successfully been employed in previous studies of steelhead on Vancouver Island (Witt et al. MS 1980; Hooton and Lirette 1986) and in British Columbia (Spence MS 1980, MS 1981; Lough MS 1980, MS 1981, MS 1983, McGregor 1986). An improved understanding of the migration behaviour of Salmon River steelhead will inherently result in better management of the resource.

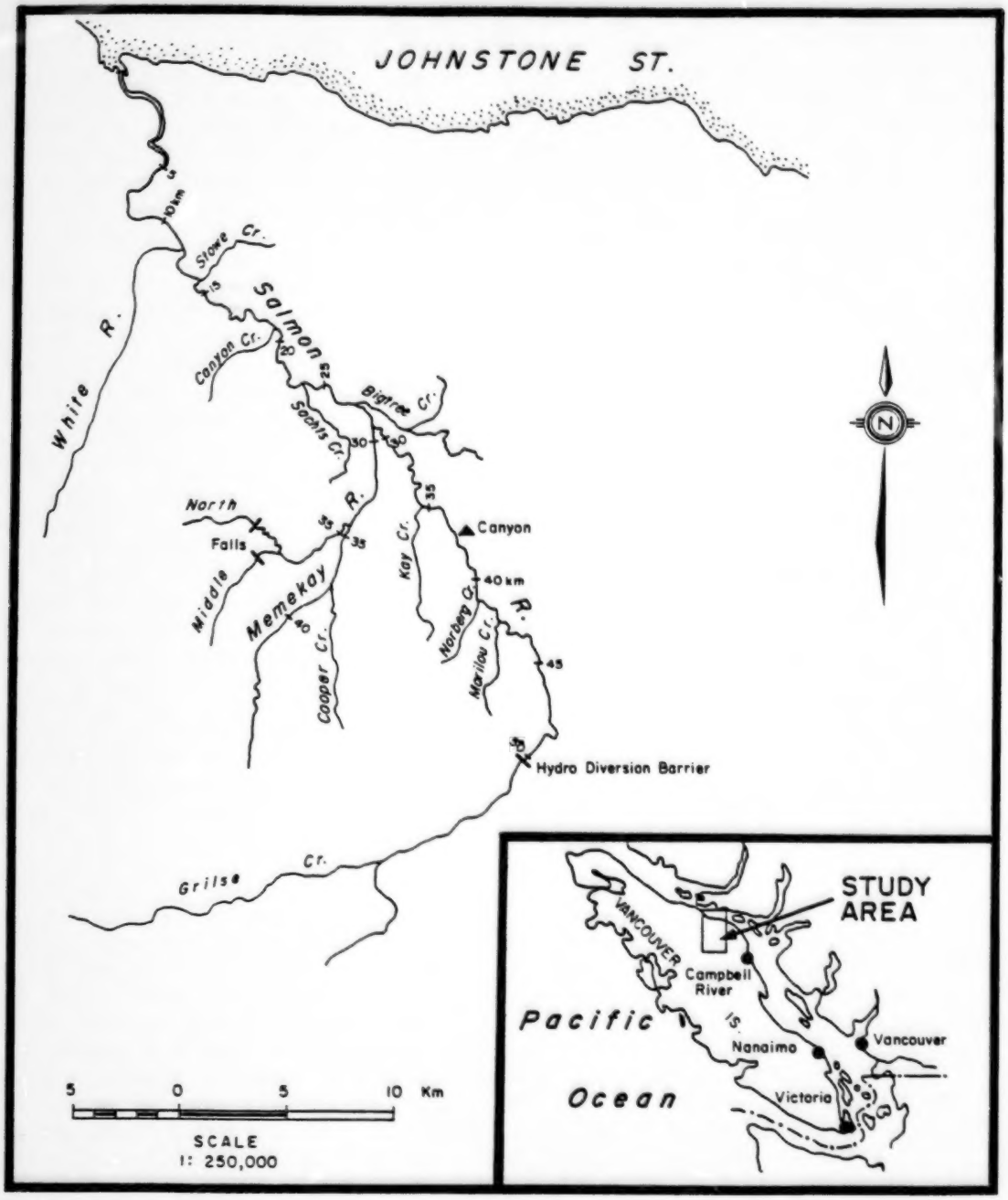

Fig. 1. The Salmon River, showing the main tributaries, its location on Vancouver Island, and the Pacific coast of British Columbia.

Specific objectives of the study were:

- to determine instream movement of winter-run steelhead in relation to time of tagging and release location.
- to determine spatial and temporal distribution of tagged steelhead spawners.
- to determine post-spawning survival, emigration rate and timing.

METHODS

STUDY SITE

The Salmon River is located on northeastern Vancouver Island, approximately 65 km north of the town of Campbell River (Fig. 1). It supports populations of chinook (Oncorhynchus tshawytscha), coho (O. kisutch), chum (O. keta), pink (O. gorhuscha) steelhead, cutthroat (S. clarki clarki), and Dolly Varden (Salvelinus malma). The mainstem Salmon River flows 80 km northwesterly from Strathcona Provincial Park to Kelsey Bay on Johnstone Strait. With a watershed area of 1200 km^2, it is the fourth largest river system on Vancouver Island. Mean monthly discharge ranges from 16.9 m^3/s in August to 93.9 m^3/s in December (Water survey of Canada 1983). Minimum and maximum daily discharges have been recorded at 2.58 m^3/s on September 28, 1967 and 1610 $m^3/$ on January 15, 1961.

The Salmon River has two major tributaries accessible to anadromous fish. The White River, with a watershed area of 370 km^2, enters the lower Salmon 11.5 km above the estuary. It is a high gradient stream with several canyons and supports summer-run steelhead, coho and Dolly Varden char. The Memekay River, with a watershed area of 223 km^2 enters the Salmon mainstem 28.8 km upstream of the estuary and produces significant numbers of winter-run steelhead. Numerous smaller tributaries, such as Big Tree, Cooper and Kay Creek, support steelhead and other salmonids.

CAPTURE AND TAGGING

Between January 30 and May 7, 1986, 217 steelhead were captured by angling and beach seining the Salmon River. Fish were captured from the middle reaches of the river (19.6-30.5 km) and included 12 fish recaptured after initial tagging. The majority of the fish (n = 192) were angled, while the remainder (n = 25) were caught by beach seining. All unspawned steelhead were either held for brood stock programs or tagged and released. Radio tags and spaghetti-like plastic anchor tags (floy tags) were used.

Radio tags were installed in three sets:

(1) Fish captured by angling and seining and released in the middle reaches between February 7 and 17, 1986.

(2) Fish seined on February 17 at 26.8 km, tagged and air lifted for release in the lower river, 7.2 km.

(3) Fish angled and released in the middle reaches (23-27.5 km) on March 23 and 24, 1986.

Steelhead radio-tagged in February were considered early-run fish, while those captured in late March were considered late-run fish.

The radio tags used in the study were Wildlife Materials (R.R. #1, Carbondale, IL) Model HLPI-2120 with external antennae and Lotec Engineering (11 Yonge Street, South Aurora, Ont.) Model FRT-4 with internal antennae. Transmitters were individually identifiable with varying frequencies from 150.053 to 151.097 Hz and had a life expectancy of 200 days. The HLPI-2120 acrylic coated tag was 6.0 cm long, 2.4 cm in diameter and had a 28 cm whip antenna. The FRT-4 wax coated tags were 6.5 cm long and varied in diameter from 1.7 to 2.2 cm between one end and the other. The tapered diameter reduced the potential for regurgitation of the smaller diameter tags. Transmitters were orally inserted into the stomach, as described in Hooton and Lirette (1986), and adapted from McCleave et al. (1978). Information on sex, approximate length, color, scars and wounds was recorded.

Two receivers were used during the study, a Telonics (932 E. Impala Ave, Mesa, Arizona) Model TR-2/TS-1 and an Advanced Telemetry radio receiver. Both receivers had programmable scanning capabilities. Telonics Model RA-3, three-element yagi antennae were used for both receivers. Movements of radio-tagged fish were monitored weekly using a Bell 206 Jet Ranger helicopter. Occasionally, locations of fish were determined from a jet equipped river boat. Locations of radio-tagged steelhead were recorded on large scale maps of the Salmon River. Locations were within 500 m when determined from the air, and within 50 meters when detected from a boat.

RESULTS AND DISCUSSION

CAPTURE AND TAG DISBURSEMENT

Among 217 steelhead captured, 61 were used for brood stock programs, 28 were radio tagged and released, 34 were anchor tagged and released, 71 kelts were released untagged, 12 fish were recaptured and 11 were hooking mortalities (Table 1). Females predominated in the angler catch at 1.9:1, while net caught fish were 1.1:1, females:males. There were 11 (5.7%) observed hooking mortalities associated with the angling of 192 fish. This was slightly higher than the average 3.4% mortality observed among steelhead angled for brood stock on Vancouver Island (Hooton 1987 in press). Tagging dates, locations, sex and approximate lengths of radio- and anchor-tagged fish are summarized in Tables 2 and 3.

Table 1. Fate of steelhead captured in the Salmon River (19.6 - 30.5 km) between January and May, 1986 (H - adipose fin clipped, R - recaptured and K - kelted).

Date	Brood stock		Radio Tagged		Anchor Tagged		Released Untagged or Recaptured		Hooking Mortalities	
	F	M	F	M	F	M	F	M	F	M
Jan 30					1	1				
Feb 07			1	1		1		1(R)		1(H)
Feb 17*	5	4	7	5	1(H)	3(3H)				
Feb 27/28	7	6			2		8(1H1R)	1(R)	3(1H)	1
Mar 06/10	27	12				10(1H)	5(1R)	6(3R)	3	1
Mar 23			2	2	5		2			
Mar 24			5	5	3	2	3(3K1R)			
Apr 07					4	1	4(4K)		1	
Apr 22							21(17K3R)	10(1R)	1	
Apr 29							10(8K)	3		
May 07							7(7K)	2		
TOTAL	39	22	15	13	16	18	60	23	8	3

* - Fish captured by seine net

TRANSMITTER VIABILITY AND RETENTION

Of 28 steelhead radio tagged, 23 (82%) were monitored through to spawning and 20 (71%) were tracked to emigration. Two of the five Wildlife Material tags produced weak signals which were undetectable at normal tracking distances. It was assumed that these older tags became unreliable following extended shelf life (greater than two years). One radio-tagged fish disappeared. Five radio tags (18%) were recovered from the river bed. These may have been regurgitated tags, but the possibility of pre- or post-spawning mortality cannot be discounted. Four of these five tag "losses" appear to have occurred after spawning (56, 58, 70, and 86 days after tagging). The fifth tag was found on the stream bank 200 meters up Big Tree Creek, 10 days after tagging. Sex (3 female and 2 males) and size (73-81 cm) did not appear to influence tag loss (regurgitation). All the tags recovered were model #FRT-4 and three were tags originally inserted with the enlarged end down. With the small end (1.7 cm) towards the mouth, regurgitation may have been more probable.

Table 2. Temporal and spatial disbursement of radio transmitters in Salmon River steelhead, February-March 1986.

Tagging Date	Fish Number	Group	Sex	Length (cm)	River km Released	Transmitter Frequency	Fate+	Recaptured Date	Recaptured km	Comments
07/02/86	1	ONE	M	90	26.8	151.091	E			Whip Antenna
07/02/86	2	ONE	F	72	26.8	151.097	E	24/03/86	@ 27.5	Whip Antenna
17/02/86	3	ONE	M	95	26.8	150.053	E			Large Up *
17/02/86	4	ONE	F	77	26.8	150.081	R			Large Down
17/02/86	5	ONE	M	75	26.8	150.109	R	01/03/86	@ 25.8	Large Down
17/02/86	6	ONE	F	89	26.8	150.121	E			Large Up
17/02/86	7	ONE	F	73	26.8	150.160	R			Large Up
17/02/86	8	TWO	F	73	7.2	150.071	E	22/04/86	@ 29.0	Large Down
17/02/86	9	TWO	M	79	7.2	150.090	E			Large Up
17/02/86	10	TWO	F	81	7.2	150.100	R			Large Down
17/02/86	11	TWO	F	83	7.2	150.141	E			Large Down
17/02/86	12	TWO	M	85	7.2	150.151	E			Large Down
17/02/86	13	TWO	F	76	7.2	151.011	M	01/04/86	@ 25.0	Whip Antenna
17/02/86	14	TWO	M	88	7.2	151.095	E			Whip Antenna
23/03/86	15	THREE	M	68	27.5	150.170	D			Large Up
23/03/86	16	THREE	F	76	27.5	150.181	E			
23/03/86	17	THREE	M	80	27.5	150.189	E			
23/03/86	18	THREE	F	69	27.5	150.211	E			Large Up
24/03/86	19	THREE	F	80	27.5	150.060	E			
24/03/86	20	THREE	F	68	27.5	150.131	E			
24/03/86	21	THREE	F	74	27.5	150.200	E			
24/03/86	22	THREE	F	80	27.5	150.220	E			
24/03/86	23	THREE	M	70	27.5	150.232	E			
24/03/86	24	THREE	M	85	27.5	150.249	E			
24/03/86	25	THREE	M	75	27.5	150.310	E			
24/03/86	26	THREE	M	84	27.5	150.321	E			
24/03/86	27	THREE	M	74	23.0	150.330	R			
24/03/86	28	THREE	F	80	27.5	151.056	M			Whip Antenna

+E - tracked to emigration
R - tag recovered (tag regurgitated or fish died)
M - tag malfunctioned (old transmitters)
D - tag disappeared
* - insertion of tapered radio tags: large up, large end towards the mouth; large down, large end towards the tail.

Table 3. Temporal and spatial disbursement of anchor tags in Salmon River steelhead, January-April 1986.

Date	Sex	Length (cm)	River km Released	Tag Color	Tag Number	Recaptured* Date	km	Comments
30/01/86	M	70	28.6	Y	10999/11000			
30/01/86	F	82	24.5	Y	10997/8			
07/02/86	M	72	25.8	O	30901/2	07/02/86	@ 25.8	
17/02/86	F	80	26.8	Y	20232/3	27/02/86	@ 25.8	Seined Hat. Fish
17/02/86	M	60	26.8	Y	20234/5			Seined Hat. Fish
17/02/86	M	62	26.8	Y	20236/7			Seined Hat. Fish
17/02/86	M	64	26.8	Y	20238/9			Seined Hat. Fish
27/02/86	F	65	19.6	O	30951			
27/02/86	F	79	26.8	Y	20250/1	07/03/86	@ 30.5	
09/03/86	M	70	27.5	Y	20263/4			
09/03/86	M	75	28.8	Y	20265/6	09/03/86	@ 28.8	
09/03/86	M	70	29.8	Y	20268/9	09/03/86	@ 29.8	
09/03/86	M	68	28.8	Y	20270/1			
09/03/86	M	82	28.6	Y	10976/7			
09/03/86	M	93	27.5	Y	10978/9			
09/03/86	M	82	27.5	Y	20267/72	13/03/86	@ 26.0	
09/03/86	M	80	27.5	Y	10980/1	02/03/87	@ 28.8	
09/03/86	M	92	27.1	Y	10982/3			
09/03/86	M	72	25.0	Y	10984/5/6			Hatchery Fish
23/03/86	F	78	27.5	Y	20473/4			
23/03/86	F	80	27.5	Y	20471/2			
23/03/86	F	62	27.5	Y	20450/1			
23/03/86	F	75	27.5	Y	20452/3			
23/03/86	F	75	27.5	Y	20454/5			
23/03/86	M	83	26.8	Y	20456/7			
23/03/86	M	65	27.5	Y	20460/1			
23/03/86	F	80	27.5	Y	20458/9			
23/03/86	F	70	27.5	Y	20462/3			
23/03/86	F	82	27.5	Y	20200/1			
07/04/86	F	81	30.5	Y	20202/3			
07/04/86	M	75	28.8	Y	20204/5			
07/04/86	F	74	28.8	Y	20206/7			
07/04/86	F	62	27.5	Y	20208/9			
08/04/86	F	80	27.5	Y	20210/11			

*Floy tag number from one recaptured fish was not recorded.

RECAPTURE RATES OF TAGGED FISH

We recaptured by angling 4 of 28 (14%) radio-tagged and 8 of 34 (24%) anchor-tagged steelhead (Table 2 and 3). Hooton and Lirette (1986) showed that early season, tagged winter-run fish were recaptured at a higher rate than later tagged fish. On the Salmon River, 4 of 14 (29%) early-run radio-tagged steelhead were recaptured, while none of the late radio-tagged fish were recaptured by angling. For anchor-tagged steelhead, this trend was similar, with 7 of 19 (37%) and 0 of 15 recaptures for early- and late-tagged fish, respectively (tag number of one recaptured floy-tagged fish was not recorded).

Recapture dates and locations varied considerably between fish. Some tagged steelhead were recaptured near release locations within hours or days of tagging, while others were angled as kelts many kilometers from release locations and up to two months after tagging (Tables 2 and 3).

MIGRATION OF TAGGED FISH

The migrations of radio-tagged fish by location and date, were analyzed individually (Appendix 1) and by tag group (Fig. 2). Individual fish movement indicated extensive utilization of the mainstem Salmon River between river kms 25 to 45 and the Memekay River. Steelhead movements were characterized by rapid upstream movement, particularily with radio-tagged fish released in the lower river (Group Two), extended holding and spawning periods of up to two months, and a rapid downstream emigration to the estuary. Migration patterns indicated a limited use of the lower river (0-20 km) for holding or spawning. This low gradient area was dominated by pools with sand substrate and limited spawning, holding and rearing habitat. Weekly monitoring of all radio-tagged steelhead indicated that 61% of all observations were made above Big Tree Creek (26.8 km), an area presently closed to angling (Fig. 3). Some caution is required in interpreting these results, however, since all radio-tagged fish were originally captured in these middle reaches (20-28 km) of the Salmon River mainstem.

Maximum migration rates of individuals were estimated at 20.3 km/week upstream (Fish No. 11, Appendix 1) and 25.4 km/week downstream (Fish No. 24, Appendix 1). On average, the upstream migration was maximum at the 30-35 km section of the Salmon River (Fig. 2). Mean location for Group One and Group Three (early and late fish, released at capture point) showed only slight upstream movement after release (Fig. 2). Group Two fish (early fish seined at 26.8 km, transported and released at 7.2 km) migrated from release point to capture area in 18 days (approximately 1 km/day). It was uncertain whether this rapid upstream movement was normal behaviour and demonstrated how quickly fish migrate through the lower half of the river, or was simply a result of fish being artificially transported to the lower reaches. Attempts to capture recently immigrated steelhead in the lower river during January and February were unsuccessful, further supporting the assumption that steelhead moved rapidly through these reaches.

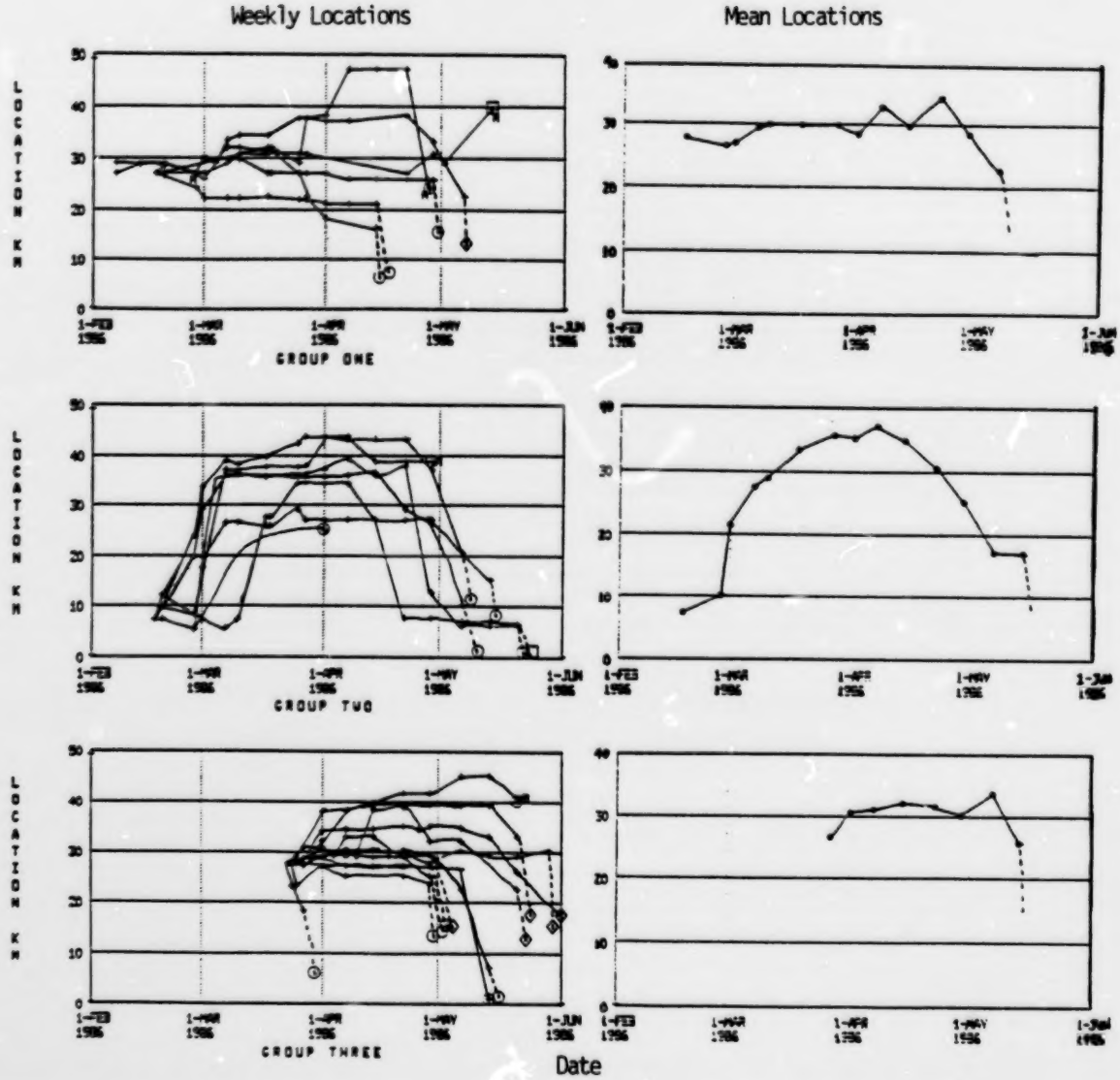

Fig. 2. Weekly locations of individual radio-tagged steelhead and mean location of groups of radio-tagged steelhead, Salmon River, February through May, 1986.

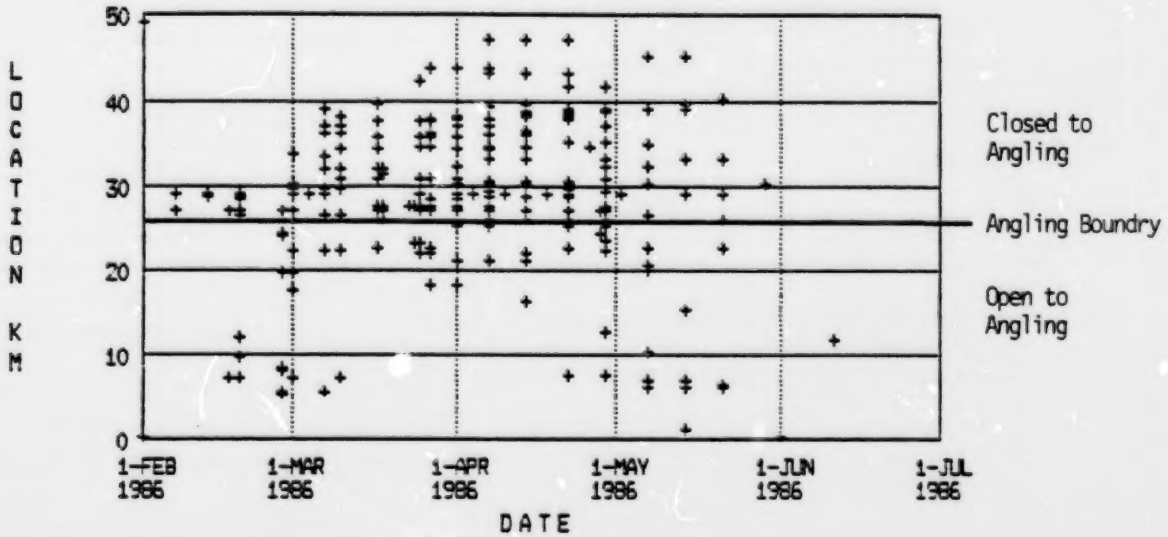

Fig. 3. Weekly tracking locations of all radio-tagged Salmon River steelhead February through June, 1986, in relation to angling restrictions.

Some peculiar fish movements were observed around the Salmon/Memekay River confluence area. Five fish (Fish No. 1, 5, 17, 20, and 22, Appendix 1) were observed migrating a short distance up the Salmon River above the Memekay River, then returning downstream below the confluence before ascending the Memekay River (Appendix 1). This type of steelhead behaviour was also observed in the Copper River, Alaska (Burger et al. 1983) and tributaries to the Skeena River, B.C. (Lough MS 1983).

SPAWNING LOCATION, TIMING AND EMIGRATION

Spawning location, determined as the area of highest upstream migration prior to emigration, revealed a wide distribution of spawners (Table 4, Fig. 4). Spawning occurred from kms 20 to 47 of the mainstem Salmon River and kms 30 to 39 of the Memekay River. A concentration of steelhead spawning (39%) occurred between 26 and 32 kms of the mainstem. Approximately 74% (17 fish out of 23) of the radio-tagged fish whose spawning area was determined, chose sites above the Salmon/Memekay confluence (28.8 km). Of these, 59% (10 fish out of 17) utilized the Salmon River while 41% (7 fish out of 17) spawned in the Memekay River. Two radio-tagged steelhead were located in Cooper and Norberg Creek (Fish No. 20 and 9, Appendix 1) and two near the confluences of Kay and Sacht's Creek (Fish No. 11 and 19, Appendix 1). The importance of these small tributaries to steelhead production should not be underestimated.

Four radio-tagged steelhead (17%) utilized the newly accessible habitat above the Salmon River canyon (38 km). This confirmed the ability of steelhead to successfully migrate through the canyon. Prior to 1975 few, if any, steelhead utilized the stream above a boulder obstruction located in the canyon. These tagged fish are assumed to be adults returning from fry stocking above the canyon in 1980 and 1981. This cannot be confirmed, however, since the fry were unmarked and the adults could be a result of straying.

The radio-tagged steelhead that migrated and spawned above the Salmon/Memekay confluence displayed behavioral differences between early- and late- tag groups. Early-tagged fish utilized the Salmon River mainstem (8 fish out of 10), while the majority of Memekay River migrants (5 fish out of 7) were late-tagged fish. These temporal and spatial distribution differences suggested the presence of distinct stocks. This was supported by comparison of size of steelhead captured prior to and after March 15, the average fork length of early-run steelhead (including brood stock, R. Billings, pers. comm.) was 78.8 cm (n = 96), while late captured fish (kelted females not included) averaged 75.3 cm (n = 29). Sampling bias was likely (small sample size and not stratified by sex) and further sampling in the upper Salmon and Memekay Rivers is required to confirm stock differences.

Spawning was estimated to have occurred between March 1 and May 14, 1986. Steelhead taken for brood stock (all were early run) spawned between March 17 and April 6 (R. Billings, pers. comm.). Again, a temporal separation appeared to exist between early- and late-tagged groups. The majority of early radio-tagged fish spawned in late March and early April, while late-tagged fish spawned in late April and early May (Table 4). Emigration timing also reflected this temporal separation. Steelhead that emigrated from the Salmon mainstem left the river in late April and early May and steelhead that utilized the Memekay system left the river in late May.

Exceptions to the typical kelt emigration downstream were observed among two, Group Two fish (Fish No. 11 and 12, Appendix 1). These individuals delayed in their lower river release vicinity (7 km) for 3 to 5 weeks before resuming emigration. The significance of this behaviour was unknown.

Table 4. Estimated spawning area, date and emigration time of radio-tagged Salmon River steelhead, 1986.

Fish Number	Group	Sex	Spawning Area Stream	km	Spawning Time	Emigration Week	Comments
1	ONE	M	Memekay	37-38	Mar 25-Apr 22	May 07	
2		F	Upper Salmon*	29-30	Mar 01-Mar 10	Apr 29	Angled as a kelt on Mar 24 at 27.5 km
3		M	Upper Salmon	30-31	Mar 10-Mar 18	Apr 14	Regurgitated
4		F	Upper Salmon	46-47	Apr 07-Apr 22	—	
5		M	Upper Salmon	30-32	Mar 07-Mar 27	—	Tag discovered in N.Memekay on May14
6		F	Lower Salmon	21-22	Mar 25-Apr 01	May 14	
7		F	—	—	—	—	
8	TWO	F	Upper Salmon	35-36	Mar 07-Apr 14	May 07	Angled as kelt on Apr 22 at 29 km
9		M	Upper Salmon	42-44	Mar 25-Apr 22	May 14	May have spawned in Norberg Creek
10		F	Upper Salmon	43-44	Apr 01-Apr 07	—	
11		F	Upper Salmon	34-35	Mar 25-Apr 07	May 21	May have spawned in Kay Creek
12		M	North Memekay	37-39	Mar 27-Apr 22	May 21	
13		F	—	—	Mar 01-Apr 01	—	Angled as a kelt on Apr 01 at 25 km
14		M	Lower Salmon	27-29	Mar 25-Apr 29	May 07	
15	THREE	M	—	—	—	—	Disappeared
16		F	Lower Salmon	27-29	Apr 01-Apr 22	Apr 29	
17		M	Memekay	30-31	Apr 01-May 07	May 29	
18		F	Upper Salmon	30-31	Apr 02-Apr 22	May 14	
19		F	Lower Salmon	25-28	Mar 27-Apr 29	Apr 29	
20		F	Memekay	38-39	Apr 14-Apr 22	May 21	Spawned in Cooper Cr
21		F	Lower Salmon	27-28	Apr 01-Apr 07	Apr 29	
22		F	Memekay	33-34	Apr 07-Apr 14	Apr 22	
23		M	Memekay	38-39	Apr 07-May 14	May 21	
24		M	Lower Salmon	27-28	Mar 27-Apr 22	May 14	
25		M	Memekay	34-35	Apr 01-May 07	Jun 11	
26		M	—	—	—	—	Emigrated early
27		M	Upper Salmon	45-46	May 07-May 14	—	
28		F	—	—	—	—	Tag malfunctioned

*Salmon River mainstem above the confluence with the Memekay River (28 km).

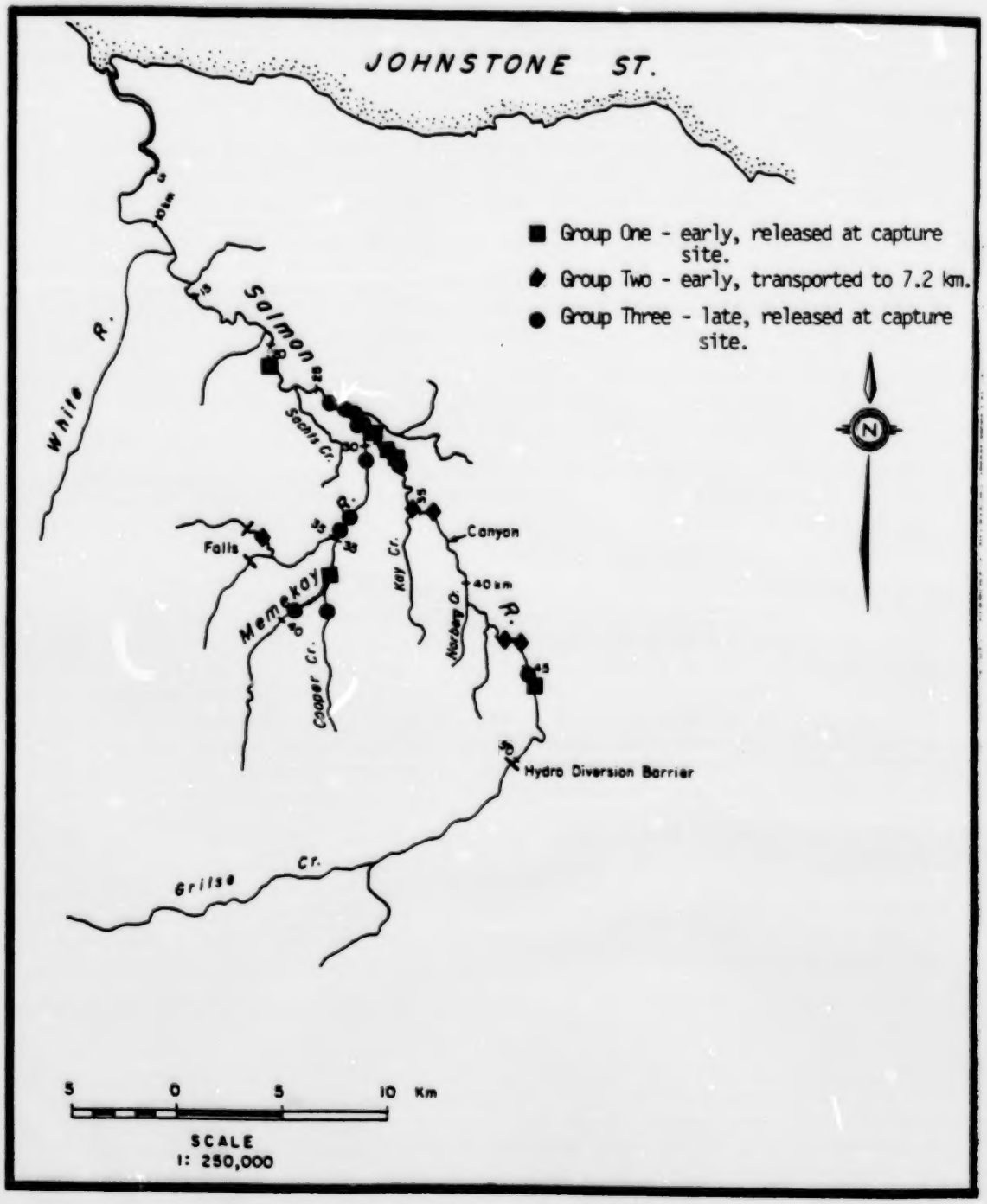

Fig. 4. Spawning area of radio-tagged steelhead in the Salmon River, 1986.

SUMMARY AND RECOMMENDATIONS

(1) Between January 30 and May 7, 1986, 217 steelhead were captured in the Salmon River for brood stock, tagging and sampling programs. Twenty-eight steelhead were radio-tagged and 34 anchor-tagged and released back into the Salmon River.

(2) Radio-tagged fish consisted of three groups:
1) February captured and released at capture site, (26.8 km);
2) February captured and released at lower river (7.0 km); and
3) Late March captured and released at capture site (23 - 27.5 km).

(3) Direct hooking mortality from angling capture was 5.7%.

(4) Twenty-three (82%) radio-tagged steelhead were tracked to spawning and 20 (71%) were monitored throuth emigration. The remaining fish either regurgitated tags, died naturally or disappeared.

(5) Four radio tagged (29%) and eight anchor-tagged fish (37%), tagged prior to March 15, 1986 (early-run), were recaptured by angling. No steelhead tagged after March 15 (late-run) was ever recaptured.

(6) Radio-tagged steelhead were located above a canyon (38 km) where an obstruction was removed by Fish and Wildlife staff in 1976. Adult returns to this newly accessible area likely resulted from fry stocking programs in 1980/81.

(7) Two stocks of winter steelhead appear to exist in the Salmon River. An early run (prior to March 15) that utilizes the Salmon River mainstem above Memekay River, spawns during late March and early April and emigrates between April 15 and May 15. A late run stock (after March 15), that utilizes the Memekay River and the Salmon River below the Memekay, spawns during late April and early May and emigrates in late May. Brood capture programs for stocking of fry in the Salmon River above the B.C. Hydro diversion dam should concentrate on the early stock to maximize potential benefits to the resource and fishery.

(8) Generally, radio-tagged fish occupied areas presently closed to all angling. Steelhead transported to the lower river (Group 2) quickly migrated upstream into areas unavailable to anglers. Provided catch and release regulations are maintained, consideration should be given to allow angling above Big Tree Creek as soon as the returns from existing enhancement efforts materialize.

(9) The preliminary results and conclusions of this study should be verified with further tagging and sampling programs.

(10) The protection of fish habitat in the Salmon River is essential to the long-term health of the existing salmonid populations and the success of the various enhancement programs. The utilization of the middle and upper mainstem Salmon River, the Memekay River, Cooper, Norberg and Kay Creeks by radio-tagged steelhead provides evidence of the widespread use of the watershed. The protection of the Salmon River above the B.C. Hydro dam is paramount if the benefits of past and future enhancement are to be realized.

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Appendix 1. Weekly locations of individual radio-tagged steelhead, Salmon River, February through June, 1986.

Legend

✦--- Mainstem Salmon River

⧫--- Mainstem Memekay River

⊞--- Middle/North Fork Memekay River

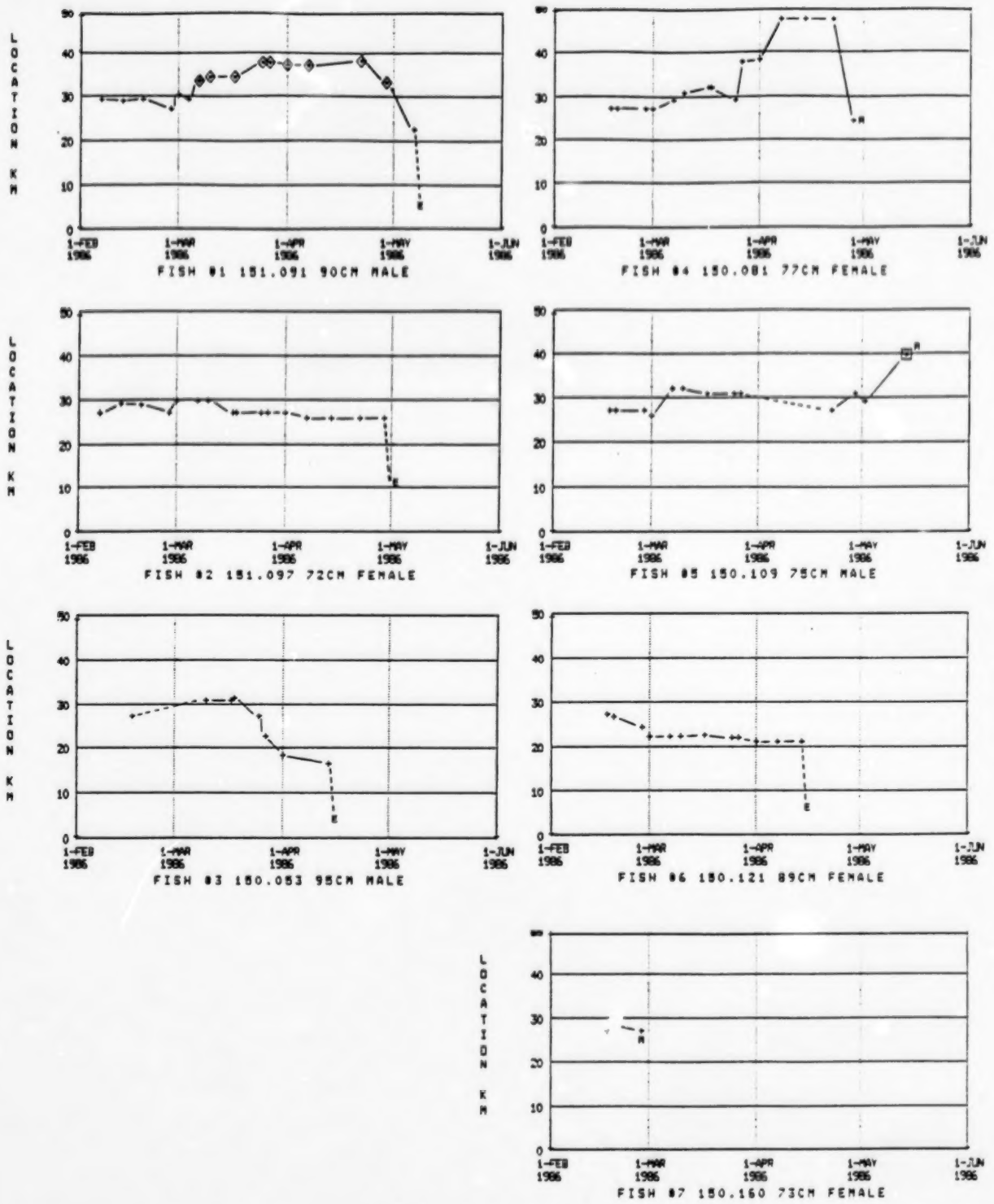
⊕--- Tributary Stream (Norberg or Cooper Creek)

R --- Recovered radio tag (Regurgitated or fish died)

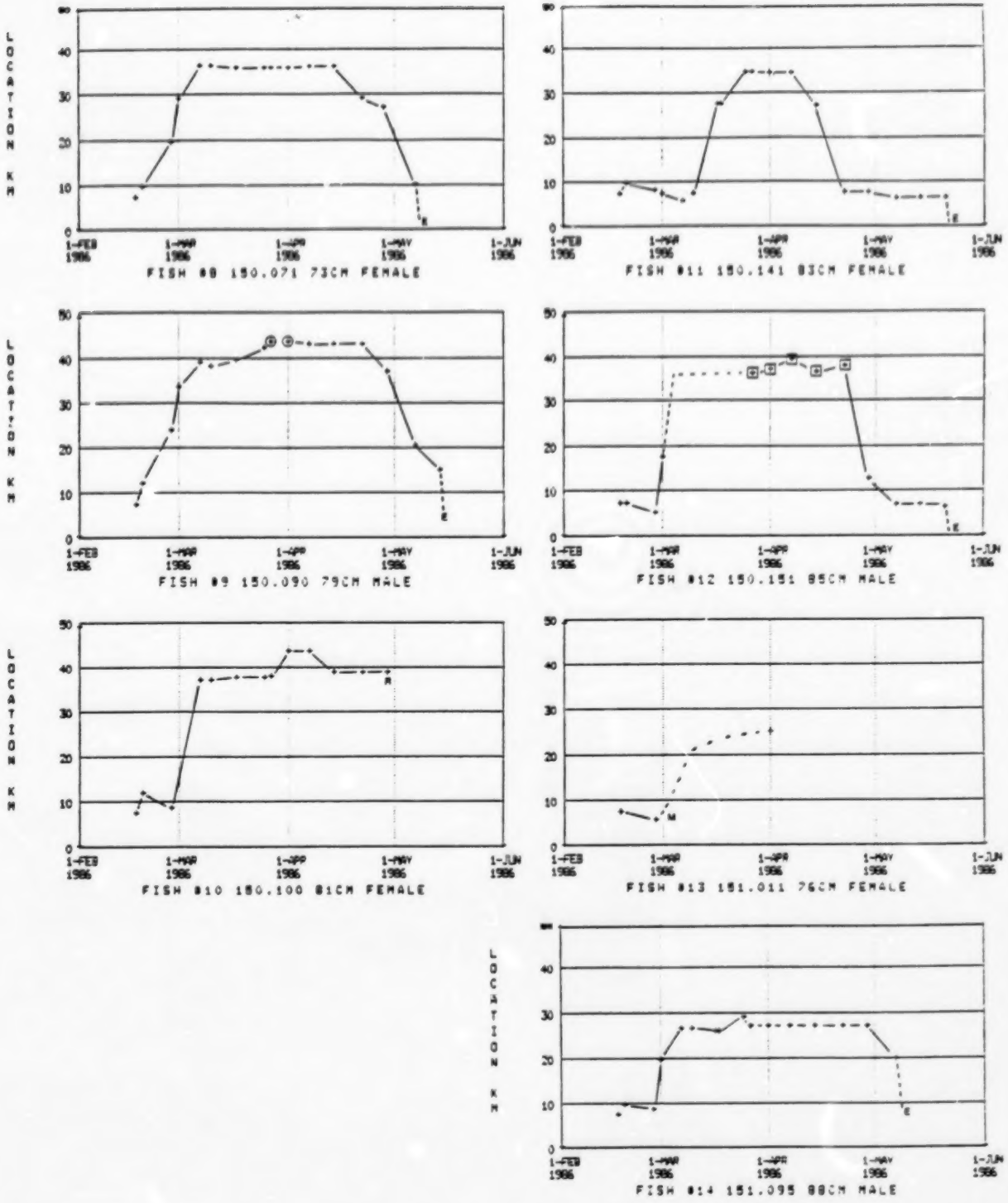
E --- Emigrated to Ocean

M --- Radio tag malfunctioned

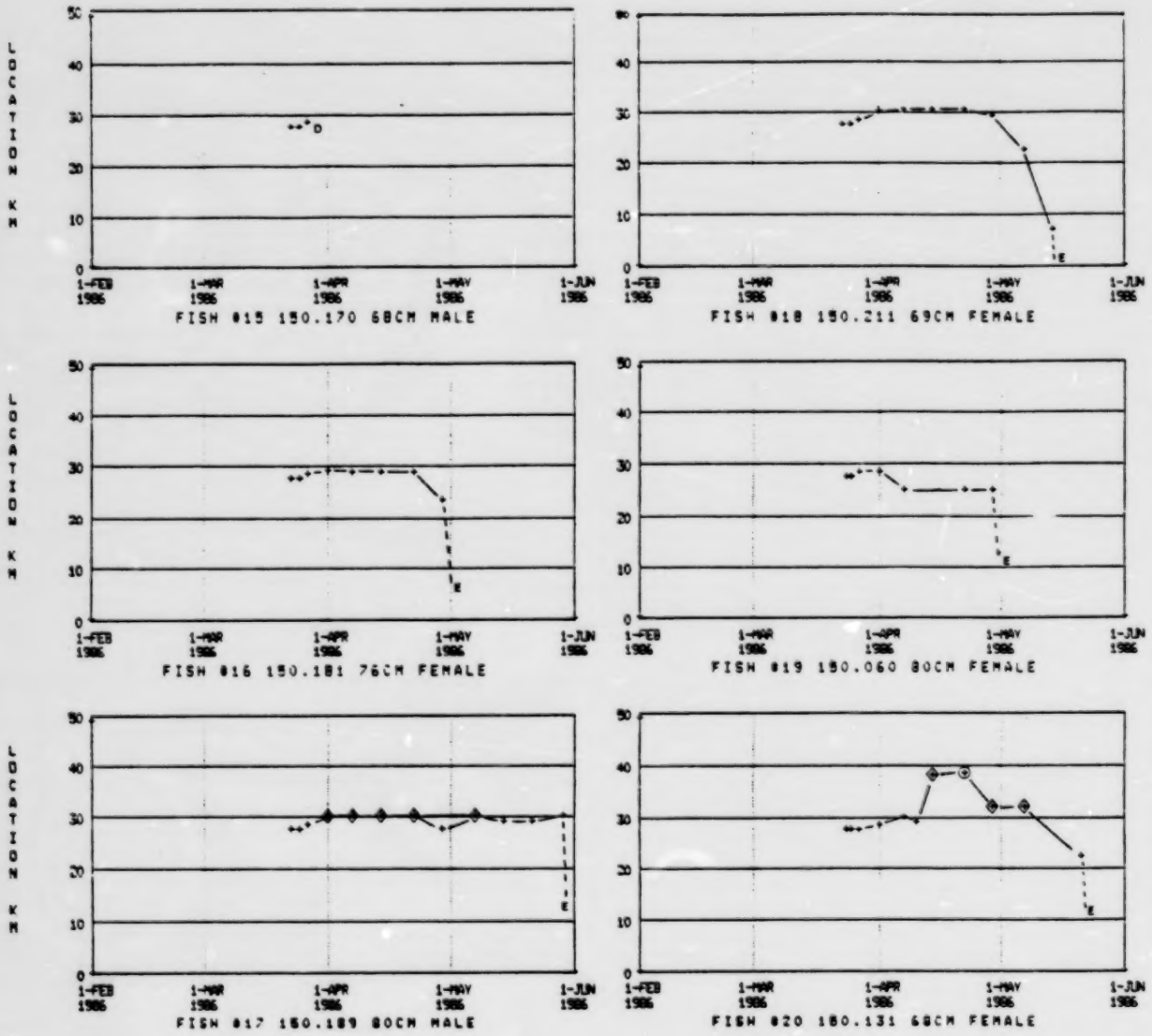
D --- Radio tag disappeared



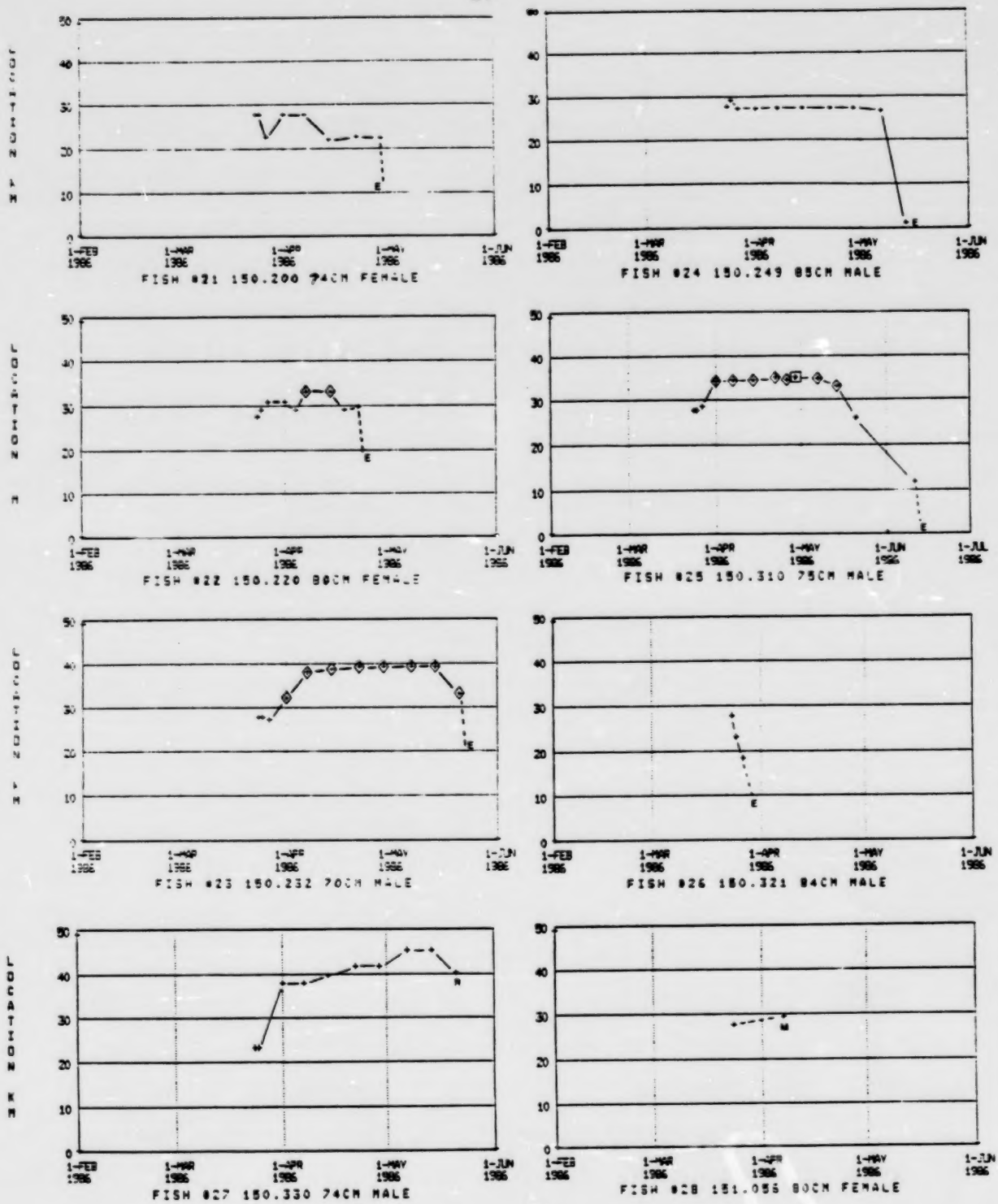
Appendix 1 (page 1). Group One steelhead, early-run tagged and released at capture site.


LOCATION KM
FISH 08 150.071 73CM FEMALE
FISH 011 150.141 83CM FEMALE
FISH 09 150.090 79CM MALE
FISH 012 150.151 85CM MALE
FISH 010 150.100 81CM FEMALE
FISH 013 151.011 76CM FEMALE
FISH 014 151.095 88CM MALE

Appendix 1 (page 2). Group Two steelhead, early-run tagged and transported and released at 7.2 km.



Appendix 1 (page 3). Group Three steelhead, late-run tagged and released at capture site.


FISH #21 150.200 74CM FEMALE
FISH #24 150.249 85CM MALE
FISH #22 150.220 80CM FEMALE
FISH #25 150.310 75CM MALE
FISH #23 150.232 70CM MALE
FISH #26 150.321 84CM MALE
FISH #27 150.330 74CM MALE
FISH #28 151.055 80CM FEMALE

Appendix 1 (page 4). Group Three steelhead, late-run tagged and released at capture site.

List of previous Fisheries Technical Circulars

1986 74 Lirette, M.G., R.S. Hooton and V.A. Lewynsky. Preliminary Steelhead Production Capability Estimates for Selected Vancouver Island Streams.

1986 75 Tsumura, K. and J.M.B. Hume. A Comparison of Precociousness in Three Graded Size Classes of Hatchery-Reared Rainbow Trout (Salmo gairdneri).

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1986 86 Hooton, R.S. & M.G. Lirette. Telemetric Studies of Winter Steelhead, Gold River, 1982-83.

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